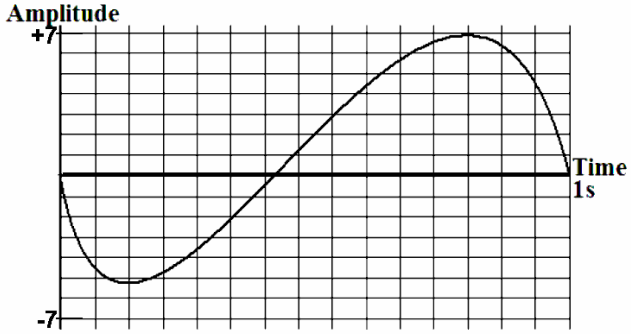
CSE Department, North South University
ETE131: Introduction to Telecommunication and Computer Engineering (SyR)
Quiz 5: 15 Marks, 20 Minutes

Name: _____ Sec: _____ ID: _____

**Question 1:** You are given the following analog wave. You are required to convert it into digital code using Pulse Code Modulation. The number of voltage levels to be used is 16 (i.e. using 4 bits S/M to represent -7 to +7). [8]




- Assuming the sampling rate is 5 per second, use PAM and quantization to give the bit value at each sample. (Note: Start at 1/5s, then 2/5s and so on)
- Show the encoding of this signal as a string of binary digits.

PTO

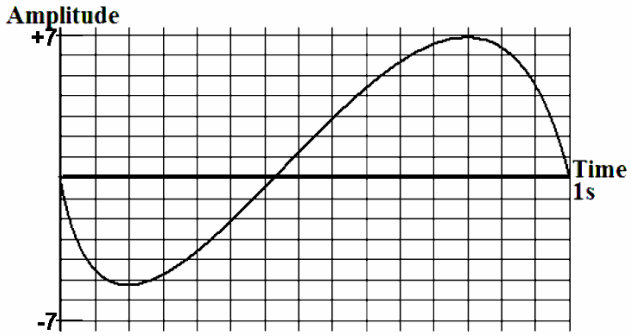
**Question 2:** Consider two media used as the core and cladding of an optical fiber: flint glass (refractive index=1.57) and quartz (refractive index=1.45). Calculate the critical angle for total internal reflection and the numerical aperture for this optical fiber [4].

**Question 3:** For a particular optical fiber system, the attenuation is given as 0.5dB/km. If the power input and output are given as 500W and 5W respectively, what is the length of the optical fiber? [3]

CSE Department, North South University
ETE131: Introduction to Telecommunication and Computer Engineering (SyR)
Quiz 5 Solutions

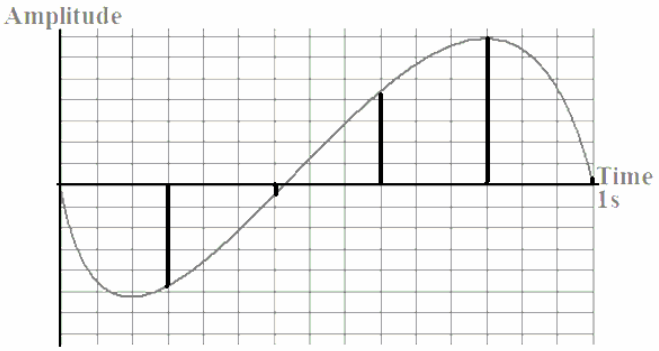
Name: _____ Sec: _____ ID: _____

**Question 1:** You are given the following analog wave. You are required to convert it into digital code using Pulse Code Modulation. The number of voltage levels to be used is 16 (i.e. using 4 bits S/M to represent -7 to +7). [8]




- Assuming the sampling rate is 5 per second, use PAM and quantization to give the bit value at each sample. (Note: Start at 1/5s, then 2/5s and so on)
- Show the encoding of this signal as a string of binary digits.

*After PAM*




At 1/5s $A = -5 = 1101_2$
At 2/5s, $A = +0 = 0000_2$
At 3/5s, $A = +4 = 0100_2$
At 4/5s, $A = +7 = 0111_2$
At 5/5s, $A = +0 = 0000_2$

Encoding: 11010000010001110000

**Question 2:** Consider two media used as the core and cladding of an optical fiber: flint glass (refractive index=1.57) and quartz (refractive index=1.45). Calculate the critical angle for total internal reflection and the numerical aperture for this optical fiber [4].

Critical angle = $\sin^{-1}(n_2/n_1) = \sin^{-1}(1.45/1.57) = 67.56^{o}$
NA = $\vee(n_1^2 - n_2^2) = \vee(1.57^2 - 1.45^2) = \vee 0.364 = 0.602$

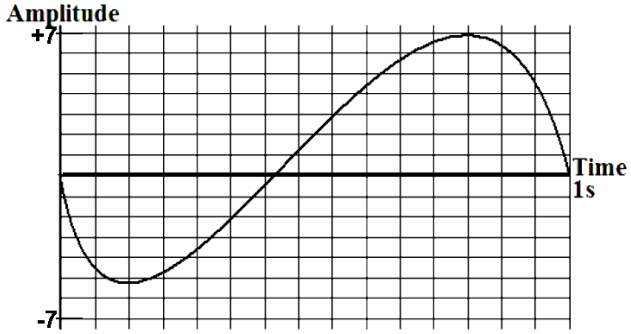
**Question 3:** For a particular optical fiber system, the attenuation is given as 0.5dB/km. If the power input and output are given as 500W and 5W respectively, what is the length of the optical fiber? [3]

$G$ = 10 log (5/500) = 10 log 0.01 = -20dB i.e. attenuation = 20dB
Attenuation is 0.5dB/km, therefore distance = 20/0.5 = 40km

CSE Department, North South University
ETE131: Introduction to Telecommunication and Computer Engineering (SyR)
Quiz 5: 15 Marks, 20 Minutes

Name: _____ Sec: _____ ID: _____

**Question 1:** You are given the following analog wave. You are required to convert it into digital code using Pulse Code Modulation. The number of voltage levels to be used is 16 (i.e. using 4 bits S/M to represent -7 to +7). [8]




- Assuming the sampling rate is 5 per second, use PAM and quantization to give the bit value at each sample. (Note: Start at 1/5s, then 2/5s and so on)
- Show the encoding of this signal as a string of binary digits.

PTO

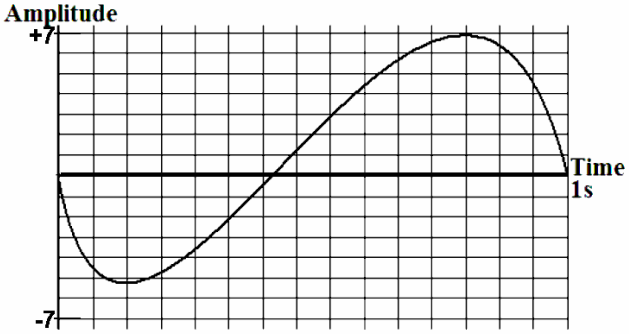
**Question 2:** Consider two media used as the core and cladding of an optical fiber: nylon (refractive index=1.53) and quartz (refractive index=1.45). Calculate the critical angle for total internal reflection and the numerical aperture for this optical fiber [4].

**Question 3:** For a particular optical fiber system, the attenuation is given as 2dB/km. If the power input and output are given as 100W and 10W respectively, what is the length of the optical fiber? [3]

CSE Department, North South University
ETE131: Introduction to Telecommunication and Computer Engineering (SyR)
Quiz 5 Solutions

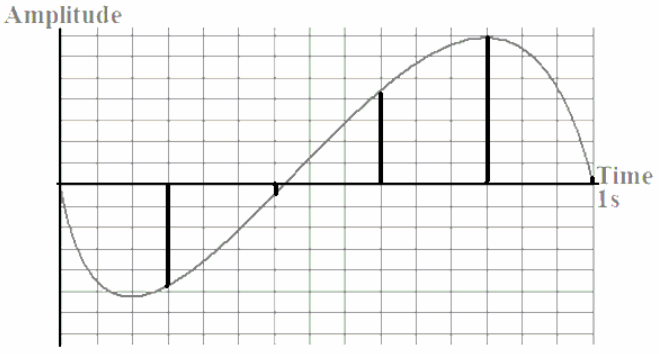
Name: _____ Sec: _____ ID: _____

**Question 1:** You are given the following analog wave. You are required to convert it into digital code using Pulse Code Modulation. The number of voltage levels to be used is 16 (i.e. using 4 bits S/M to represent -7 to +7). [8]




- Assuming the sampling rate is 5 per second, use PAM and quantization to give the bit value at each sample. (Note: Start at 1/5s, then 2/5s and so on)
- Show the encoding of this signal as a string of binary digits.

*After PAM*




At 1/5s $A = -5 = 1101_2$
At 2/5s, $A = +0 = 0000_2$
At 3/5s, $A = +4 = 0100_2$
At 4/5s, $A = +7 = 0111_2$
At 5/5s, $A = +0 = 0000_2$

Encoding: 11010000010001110000

**Question 2:** Consider two media used as the core and cladding of an optical fiber: nylon (refractive index=1.53) and quartz (refractive index=1.45). Calculate the critical angle for total internal reflection and the numerical aperture for this optical fiber [4].

Critical angle = $\sin^{-1}(n_2/n_1) = 1.45/1.53 = 71.39^o$
NA = $\vee(n_1^2 - n_2^2) = \vee(1.53^2 - 1.45^2) = \vee 0.238 = 0.488$

**Question 3:** For a particular optical fiber system, the attenuation is given as 2dB/km. If the power input and output are given as 100W and 10W respectively, what is the length of the optical fiber? [3]

$G = 10 \log (10/100) = 10 \log 0.1 = -10$dB i.e. attenuation = 10dB
Attenuation is 2dB/km, therefore distance = 10/2 = 5km